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FOUNDRY TRADE JOURNAL
Established 1902
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Vol. 71 Thursday, September 23, 1943 No. 1414

Castings Replace Heavy Forgings

We have long been advocating for the steel foundry industry a policy which will include a technical publicity programme designed to inform engineering executives of the potentialities of their products. For their files we print below a paragraph written by the Editor in the August issue of "Metal Progress." It carries the same caption as this article, and says: "Hardly through the door of the first shop at Dominion Engineering Works in Montreal, chanced upon an instance where castings were replacing forgings and no one much to blame but the forge shop. Suppose you were making steam engines for Liberty Cargo Ships and were getting rough forgings (and I'll say they're rough) weighing 3,800 lbs. which ultimately machined down to 1,500, and found you could get steel castings weighing only 2,350 lbs., suitable for the same service and saving 35 to 50 machine-hours of time in finishing. Would you hesitate which one to choose? 'Oh, yes,' you'd say, 'but how about the physicals?' Well, the marine inspection and insurance companies are not so much interested in strength of connecting rods as in plasticity—in fact there is a maximum and minimum specified on ultimate. and a minimum on elongation. Composition of the castings and the forgings is about the same (C 0.30 per cent., Mn 0.75 per cent., Si 0.25 per cent.), except that silicon in the castings is somewhat higher; elongation in 2 in. is a little less (30 per cent. in place of 35 per cent. for the forging), but there is little or no difference between longitudinal and transverse directions in the cast rod. Izod impact of the annealed forgings varies from 25 to 60 ft.-lbs., corresponding to whether the grain size is coarse or fine; for the castings it ranges around 35, they having a relatively fine grain size from their heat-treatment: First, air cool from 900 deg. C., and then air cool or furnace cool from 830 deg. C., depending on analysis. . . . Now which one would you choose?" This is not by any means an isolated case, and the American and Dominion technical Press are constantly printing similar instances, and also show a weight saving of over 30 per cent., associated with similar reductions in machining time. The rôle which the steel foundry has played in marine construction has been eloquently described by Dr. Dorey in the last Edward Williams lecture, and those who had the privilege of being present when the lecture was delivered must have been impressed by the superior sense of publicity values by the Continental steel founder. The photographs exhibited of an extremely large steel casting did justice to its size by artistically grouping within it the workmen who had been responsible for its creation. Such pictures have a double publicity value, inasmuch as they impress upon the engineer the resources of the foundry and give to the operatives a feeling of pride of accomplishment. We are well informed as to the progress which the steel founding industry has made during the war, and we are convinced that there is wealth of material available for combatting the competition to be expected from forgings in the post-war period, providing it is properly marshalled and attractively publicised.

CANADIAN BLAST FURNACES

The construction of new blast furnaces in Canada is adding substantially to the Dominion's pig-iron capacity. Algoma Steel Corporation, Limited, are just completing extensive new plant started in 1941, and estimated to cost about $14,000,000. which includes a new blast furnace and coke ovens. This furnace, which will have a capacity of 1,000 tons per day, increases the number of Algoma furnaces to five. The Dominion Steel & Coal Corporation is completing a new blast furnace at its Sydney works which will also be of 1,000-tons-per-day capacity.

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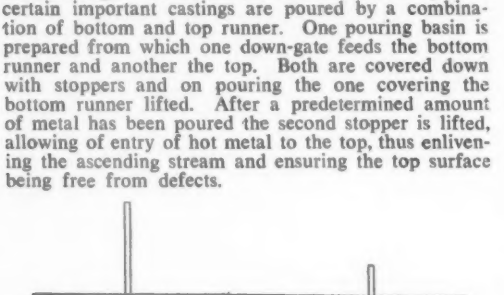
FOUNDRY INQUESTS—III.

By "Coroner."

Top or bottom running of certain castings have ofttimes been discussed. The advocates of bottom running maintain that a cleaner casting is the result, as there is not the same erosion of the sand as when the metal is top poured. On the other hand, castings bottom poured are likely to exhibit defects on top faces, such as entrapped gas or shrinkage, depending on the design. To obtain the benefits of both systems certain important castings are poured by a combination of bottom and top runner. One pouring basin is prepared from which one down-gate feeds the bottom runner and another the top. Both are covered down with stoppers and on pouring the one covering the bottom runner lifted. After a predetermined amount of metal has been poured the second stopper is lifted, allowing of entry of hot metal to the top, thus enlivening the ascending stream and ensuring the top surface being free from defects.



This system had been operating successfully on a particular job, and surprise was expressed at seeing in the fettling shop a casting exhibiting a bad top face. Inquiry revealed that the moulder usually on the job being absent, another man made up the runner basin in which he made the height of the seats for the two stoppers the same. This resulted in the second stopper to be lifted being immersed in molten iron for a considerable period, with the consequent burning off of the stem, making it impossible to lift; thus all the metal had to pass through the bottom runner. A section of the correct runner basin is shown in Fig. 1, A being the first stopper removed and B the second. By this arrangement the stem part of B is not in contact with the molten metal, and no danger of burning off is present. The defective casting was due to both stoppers being on the level of A, a simple mistake which was costly and caused "an inquest."

Canadian steelfoundry capacity has been much expanded since the outbreak of war. The output of castings has risen from 61,000 tons in 1939 to 160,000 tons in 1942.

FORMATION OF AN X-RAY ANALYSIS GROUP

It is announced that, in response to the request made by the Second Conference on X-ray Analysis, which was held in Cambridge in April last, the Board of the Institute of Physics has authorised the formation of an additional group under the auspices of the Institute. The new group is empowered to arrange meetings and conferences and generally to be a medium for the exchange of information on matters relating to X-ray diffraction. The organising committee of the Conference was requested to act as the first group committee and it has elected Prof. Sir Lawrence Bragg as chairman of the Group and Dr. H. Lipson as honorary secretary and treasurer. The inaugural meeting of the Group is to be held in Manchester jointly with the Manchester and District Branch of the Institute on October 16 next; Sir Lawrence Bragg has consented to give the opening lecture, "The Physical Optics of X-ray Analysis," which will be followed by other Papers on "Some Industrial Applications of X-ray Analysis."

All interested in the Group, whether members of the Institute of Physics or not, are requested to send their names and addresses to Dr. H. Lipson, F.Inst.P., the Crystallographic Laboratory, Free School Lane, Cambridge, from whom further details may be obtained. Membership of the Group is open without payment of additional fee to Fellows, Associates, students and subscribers of the Institute of Physics.

WORLD'S LARGEST CASTING

In reply to an inquiry received by the Editor of "The Iron Age" as to the weight of the heaviest casting ever made in the world and the place where it was poured, Mr. Harry Everett, of the Power Brake Equipment Company, 1416 S.E. Eighth Avenue, Portland, Oregon, wrote that "Scientific American" for April 18, 1874, page 247, contains a complete description of an anvil weighing 500 tons, with a cubic volume of 2,700 cub. ft. This anvil was made in a gun factory at Perm, in the north-eastern part of Russia. Fourteen cupolas were erected for the job. Over two months were required to cool the casting, which was completed in October, 1873.

The Editor of "The Iron Age" also recalls that a 210-ton anvil block was cast in 1867 in Great Britain by Nasmyth, Wilson & Company, and Bethlehem cast in the Lehigh plant in 1931 a 230-ton forging press cylinder jacket. Tata in India also has cast record-weight castings.

A malleable iron castings industry advisory committee has been formed in the United States to consult with O.P.A. officials on malleable-iron castings pricing matters. The chairman of the committee is Mr. R. R. Fauntleroy, Moline Malleable Iron Company, St. Charles, Ill.

STEELFOUNDRY PROBLEMS

JOINT SESSION OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE IRON AND STEEL INSTITUTE

Discussion of Three Conference Papers at London Meeting

(*Continued from page* 48.)

The Effect of Dust

MR. DEREK WELLS said that he would prefer to answer most of Mr. Kain's remarks in writing, but there were one or two points he desired to mention. Mr. Kain stated that the effect of dust had been found mainly in the case of the casual wartime labour just brought into the works, and that therefore the solution of this problem was mainly a matter of waiting until more normal conditions returned. With this he disagreed very profoundly. His own experience was that the various ways in which dust was affecting people were shown most markedly with men who had been working with them for ten or twenty years. Although this was probably not the time for a large national investigation into the matter, it was a problem to which foundries should devote their attention as soon as times were a little easier and happier.

With regard to sand in converters, they had also made experiments on that point and their experience was exactly the same as that of Mr. Kain's. When the matter was put to him originally it was claimed that it would prolong the life of the tuyeres, and in their experience the tuyeres were the first part of the lining to go. They obtained an average of 100 heats to a set of tuyeres, and it was a small matter to cut out what was left of the tuyeres, replace them, and go on for another 70 or 80 heats. They had gone as high as 1,000 tons by that means. His experience was that the addition of sand to the metal charged did not improve the life of the tuyeres at all, but rather lead to excessive "building up" of the lining and so causing a reduced capacity.

Hot Tear Susceptibility

MR. W. H. SALMON, speaking on Paper 774, said that the author had provided an excellent summary of the published information on hot tear formation in steel castings, and referred to the remark near the end of the Paper that some type of foundry test must be developed for hot tear susceptibility.

However, it was not easy to obtain a numerical index of the tendency to hot tear. Foundrymen all over the world have attempted to design test castings for this purpose, and he wondered if the author could say if any recent work had been carried out in America on this subject. The form of test should be designed with three aspects in view; first, it should be cheap to mould; secondly, it should give reproducible results, or if it is cheap enough to mould, a large number of results could be averaged; thirdly, it should give a numerical value of the tendency to hot tears in order to show the influence of the following three variables:

(*a*) *Casting Temperature.*—His opinion was that for a given design of casting there was an "ideal range" of pouring temperature. At casting temperatures below this range trouble is encountered by cold lapping, scumming, entrapping of air and foreign particles, and lack of internal fluidity which may give rise to unsound internal areas. A large proportion of foundry wasters could be attributed to the use of molten steel which was lacking in fluidity or running power. On the other hand, casting temperatures higher than the "ideal range" for any particular design, imposed a more severe action on the moulding sand, but he had not yet been able to prove whether rather higher temperatures were as serious as they had been thought to be in causing hot tears, except in the case of alloys such as Hadfield's manganese steel, which gives a gross crystallisation when cast too hot.

(*b*) *Steel Composition, Method of Manufacture and Types of Inclusion.*—He agreed with the author that sulphur was the element which caused most trouble in causing hot tears, and had found in certain cylindrical thin-walled castings that above 0.030 per cent. S there was almost a straight line increase in the percentage of "pulled" castings, as the sulphur content increased to 0.060 per cent. Below 0.030 per cent. S there was no trouble with simple designs, but with more intricate designs it was advantageous to keep sulphur as low as ever possible. With regard to the author's comment that lower carbon steels were less liable to hot tears, he was interested to read this confirmation of a recent experience with an intricate casting which showed considerably less hot tearing when the carbon content was in the range of 0.15 to 0.18 per cent. than when it was up at 0.25 per cent. C. The steelmaking difficulties are increased with the lower carbon ranges. He was surprised the author had not referred to the beneficial influence of silicon and copper on the tendency to hot tears, and he had a feeling that, as there appears to be no loss of ductility in the physical properties of steel castings if the carbon is reduced *pro rata* as the silicon content is increased, the author may have pointed the way to an advance in "steelmaking for the foundry" which would be most effective in limiting hot tears.

(*c*) *Sand Strength at High Temperature.*—The introduction of oil sands which readily collapse after casting and the recent work on the high temperature strength of clay bonded moulding sands were indications that the problem of sand properties was being considered continually by the foundryman, but he sometimes wondered whether "high temperature tests" could really reproduce the conditions which exist in the mould just after casting when the "hot tears" occur. The adoption of a standard "hot-

Steelfoundry Problems

tearing" test-piece design would be of great assistance in studying the practical aspect of sand strength in relation to hot tears.

Finally, he would like to refer to the sketches, Figs. A to D in Mr. Fassotte's notes, which showed that while a change of running and risering, and the use of internal (horse-nail) chills had been ineffective, the hot tears had been eliminated by means of a light external chill in the core. In many cases external chilling is the only means the foundryman can employ to overcome the tendency to hot tears. Every chill has to be specially shaped, cleaned and recovered after use (if possible), and many of these chills could be avoided if the foundryman and designer could be brought together while the job was still on the drawing board.

MR. COOPER said that hot tears were caused particularly by carelessness in moulding and running. It was found that in making castings they had to be very careful to use a uniform thickness of sand, and where the casting was heaviest they cut down the sand as much as they could for quick cooling. In addition to that they took great care to stop any flash in the runner and in the riser, and in the section where the boxes were closed. He just mentioned these things in passing so that anybody who was working on these lines could look to see whether the melting was sufficiently good to prevent any fault. Another mistake which was sometimes made was the use of sand which was rammed too hard.

Electrically-heated Holding Furnace

MR. BOLTON said he quite appreciated the advantages in the production of light castings in having an electrically heated holding furnace, and the combination of an electric furnace with a holding furnace had been in mind when drawing the comparison to which Dr. Dadswell referred. He did feel, however, that with an electric furnace alone, without a holding furnace, the cost of the installation would be considerably higher than that of a cupola-converter plant. Attention was drawn to this in the Paper, partly with the idea of stimulating someone to write a similar Paper from the electric furnace user's viewpoint, and it would be extremely interesting to see how the production costs actually compared.

Order of Importance

MR. F. W. ROWE, B.Sc., said that, on Paper No. 774, all that he had to say was very largely in corroboration of what other speakers had said. They were indebted to Mr. Briggs for his Paper. It was focusing attention on a somewhat neglected subject. He supposed that at the present time they had so many problems in front of them in steelfounding that it was difficult to put them in their right order of importance and to say which should be tackled first, but to his mind there was a great deal to be learned about hot tear formation in steel castings. It was nearly as great a source of trouble as shrinkage to which most of their endeavours had been directed. In that respect, he hardly thought that Mr. Briggs placed quite enough emphasis on the influence in steelmaking of the formation of hot tears.

He had had in his time one or two bitter experiences of hot tear formation, and apart from this awkward business of design, with which they were all familiar, there was no doubt that steelmaking practice had a very large influence on whether a difficult casting was going to show hot tears or otherwise. He had had a 12-ton heat of electric steel where the whole of the castings were full of hot tears from start to finish owing to errors in the refining process, and it made one realise how much one was dependent on correct steelmaking practice and also on correct control of temperature both throughout the steelmaking process and in casting.

He was glad that Dr. Dadswell had called attention to the radiographs illustrating the Paper. Those who had had any experience of radiography knew this type of defect was often revealed and had been ascribed to various causes. This type of defect was so often not revealed in machining, and the operations should be investigated in greater detail than was usually the case in order to discover whether some clue could be given to the causes. The question of slag inclusions was also important. In most steelmaking processes, however, one was torn between two fires. The defect of which they were all most afraid was gas holes due to hydrogen liberations at the moment of solidification, and that type of deoxidisation additions which obviated this defect might produce a steel liable to hot tears.

Freedom of Acid Steel from Hot Tears

MR. W. H. SALMON, speaking on Paper 774, said that he was interested in Dr. Dadswell's description of an internal defect in a steel casting 3 ft. 6in. dia. by 4 ft. high (head 2 ft. dia.), which had been cast vertically, because he had seen similar defects in the riser or immediately below the risers of heavy steel castings. There was no sign of the defects on the surface, machining showed that they commenced several inches below the surface and extended across the centre of the casting, sometimes just one horizontal layer, and sometimes there were two arrow head formations inclined upwards towards the centre. He had seen the defect in basic electric and open-hearth steel, but had not yet seen it in acid steel unless the steel had been very cold. It was probably due to the formation of a film or scum on the surface of the molten steel as it was rising in the mould, over which later steel flowed, thus trapping the film of crystallites in a horizontal layer which tended to seal off adequate feed metal from the zone immediately below it.

Probably this type of defect was really an internal cold lap. A similar defect was seen in large ingots which had not been cast quickly enough, the internal breaks in the upper portion being revealed in forging. As these internal discontinuities did not come out to the surface he would prefer to call them "internal freezing or shrinkage defects," and while admitting

that a hot tear which was revealed at the surface could be due to the fault of the moulder, he could not see how an internal cold lap could be attributed to the moulder unless he had run the job too slowly. Once a solidified skin of metal 2 in. or 3 in. thick had formed, he could not visualise how the fluid steel inside the envelope could "hot tear," but realised that shrinkage defects similar to those shown in Fig. 11 could form if insufficient reserves of fluid metal had been provided in the risers, or the feeding had been ineffective because of the earlier freezing of intermediate layers.

In conclusion, he would like to pay a tribute to the author for this stimulating and comprehensive Paper he had presented on behalf of the American Foundrymen's Association.

MR. SKIDMORE, speaking on Paper No. 774, agreed with Mr. Cooper that the majority of hot tears were caused by carelessness, but also from dozens of other causes as well, most of which, however, were rectified by the ingenuity of the foundryman. The problem of hot tears and cracks certainly went deeper than that. What the foundryman would like was more knowledge of what actually happened when a casting starts its contraction, even on a casting of equal section. A question often raised by young moulders was: Did an external hot tear start from the inner section when in a stiff pasty state or is it torn through the already solidified wall? A second was: Did a cavity have the tendency to cause a hot tear leading from a cavity to the outer wall? A personal answer was in the negative. It was quite true that foundry people did encounter tears which led to a cavity, but it was far from being the general rule, although it was claimed by many to have some connection; he thought otherwise.

Sometime ago one firm had a casting returned which had cracked after being in service some considerable time, and when it had been sawn through for inspection it did show a small cavity. The question arose as to whether it was a hot tear which was not seen by the inspection department or not. After many consultations the foundry manager was still not satisfied, and made more inquiries as to what actually happened to this casting, and found out that this casting had had a terrific smash. The casting had actually been broken. The results of the further inquiry was no torn casting. Of course, preparations were made to overcome the cavity and proceed with the job. No foundryman liked to find hot tears in any casting, and used many varied methods for eliminating them and keeping within safe limits; small V-shaped tears can and should be successfully repaired.

MR. COOPER asked whether it would not be possible, when the inside of the casting was liquid, to have a hydraulic pressure.

The CHAIRMAN (Mr. J. W. Gardom) said that he wanted in particular to thank Mr. Fassotte for his excellent introduction to the American Paper. He did not remember an overseas Paper being introduced quite so well as this one. Evidently a great amount of time had been put into Mr. Fassotte's note. The question had arisen as to what was a hot tear and when did the defect start. The Technical Committee, through various sub-committees, had tried to bring out from time to time an atlas of defects—illustrations of what was meant when certain defects were described. This would enable the descriptions in individual Papers to be better understood. Different sub-committee reports dealt with cast iron, with steel, and with non-ferrous metals, but it would be better to have a committee to deal with the whole subject, because, after all, it was all foundry work, and many castings defects were common to all three types of material.

Vote of Thanks

MR. RENDALL proposed a vote of thanks to the authors of the Papers, which he said had covered an immense field. This question of hot tears had gone to the fundamentals of temperature and temperature gradients. The other two Papers had also been masterly. The Paper by Mr. Wells and Mr. Johnson gave a review of how to apply the knowledge now available, and stressed the necessity for standardised practice. He knew that he was speaking for everyone present when he expressed their thanks to the authors for the instruction they had afforded.

MR. SPEAKES seconded the vote of thanks, which was accorded by acclamation.

MR. FAULKNER replied to the Chairman's felicitous remarks with regard to Mr. Fassotte's introduction. He said that twenty years ago he himself had with others initiated this system of international exchange Papers, of which Mr. Briggs was so excellent an example. There had now been several hundreds of these Papers exchanged throughout the world, constituting a veritable library of foundry technology. The Paper by Mr. Briggs enhanced the very high regard which British foundrymen had for the research work published by its author.

MR. BOLTON and MR. JOHNSON also expressed their acknowledgments of the vote of thanks, and the meeting then terminated.

WRITTEN CONTRIBUTIONS

Further Remarks on Paper No. 776

MR. E. J. KELLY wrote, on Paper No. 776, that mention of the whirl-gate head and atmospheric head was of particular interest to the steel-foundryman. The castings made by this method were of sharper detail; they were not disfigured by the many various types of head usually associated with these castings. Another useful feature with their use was that the mould and core material had only to stand up to the actual volume of metal needed to fill the mould proper. The head metal did not enter the mould; therefore there is less erosion on mould and core. Had the authors any data on the relative qualities of the whirl-gate head and atmospheric head on similar types of castings?

With reference to the sand problems, sustained effort had to be made in the steelfoundry at the present time to achieve good results. The nature of

Steelfoundry Problems

the bond claimed close attention. When scabbing or erosion had occurred, portions of oil-sand core may usefully be employed in such places. This practice might also be applied where the authors say it had occurred when the runner had had a scoring effect. The runner itself might be in core with good result.

The use of proprietary core compounds are with advantage used as a bond in many facing sands in the steelfoundry. The stripping qualities were excellent. But it had a much greater destroying effect on the sand mass as compared with a clay-bonded sand. Had the authors a similar experience of such uses?

Dealing with the question of dust, this was a most troublesome problem in the foundry, and the authors could be assured they were not alone with the problem; every effort was being made to solve it by methods as suggested in the Paper. Watering the floor is a very old and useful method to employ, since at least it arrests the floor dust, so readily kicked up by all. Much remained to be done, however, since this was one of the chief causes of absenteeism. Anything that could be done to alleviate the trouble will serve a most useful purpose to the foundry.

Dealing with the question of a single or synthetic sand, much useful experience and data would probably be gained from the foundries now employing this method on mass production work. Whether it could be applied with advantage to the jobbing foundry only time could tell. But it certainly suggested its usefulness and was well worth persevering with. The writer agreed with the authors on the conclusions they had reached on this matter.

Authors' Reply

MR. DEREK WELLS and MR. JOHNSON wrote thanking Mr. Kelly for his trouble in so setting out his remarks and regretted that they could not answer his two questions more fully.

Regarding the atmospheric head, the authors had merely made sufficient progress with it to visualise its possibilities, but they could not offer any comparative data between the application of this type of head and the one generally spoken of as the whirl-gate head. They were rather inclined to the view that these would gradually be merged into a "hybrid," bearing, it was hoped, all the advantages but none of the disadvantages of both parents.

Mr. Kelly's remarks on the use of oil-sand cores for runners were very apt, and either they or refractory sleeves (they each have advantages dependent upon other factors) should be used with green sand. They were not quite clear as to Mr. Kelly's comments on the "destroying effect on the sand mass of core compounds." Naturally, under the influence of the pouring temperature of the steel, these organic compounds break up, and they had little or no value afterwards from a reclamation point of view.

They had also received from Braintree the report of the remarks made by Mr. Kain, of Lake & Elliott, and as they noted Mr. Wells prefaced his verbal reply to Mr. Kain by saying that he would prefer to answer some of his questions in writing, they would like to add the following remarks to the reply to Mr. Kain.

Mr. Kain said they had not had the same experience as the authors regarding the feeding of two, three, or four small castings from one centrally placed whirl-gate head, and that he thought that this might be attributed to the use of green sand by himself as against the employment of dry sand by the authors. They felt that in this respect Mr. Kain might be right, since the examples of this use of the whirl-gate head quoted in the Paper were derived from dry-sand practice.

Mr. Kain said they had not had the same experience of Fulbond, and to reply to this fully would take up more space than was available; but, briefly, they would inform Mr. Kain that their support for the efficiency of Fulbond was based on their practice of using it as a substitute for bentonite in increasing the compression strength of moulding sand. To be more precise, they had not had as much experience as Mr. Kain in reclaiming 80 to 85 per cent. of the sand used in the foundry, and therefore on this point they must accept the experience of Mr. Kain that Fulbond does not have such a good "life" as bentonite in that it calls for very much bigger additions of new sand to each batch milled; just as in the past they had used bentonite to strengthen the moulding sand for heavy castings of some tons in weight, so they had found Fulbond an adequate substitute. They therefore felt that this was another case where their findings might differ because their use of the material in question was also fundamentally different.

The authors appreciated very much Mr. Kain's comments on the question of foundry maintenance, and the fact that they did not themselves comment on this problem in their Paper must certainly not be taken to mean that they regarded the matter as insignificant. The authors agreed entirely with Mr. Kain's remarks and had themselves had the same experience. The shortage of really skilled maintenance men, together with the fact that most foundries had added considerably to their mechanised plant during the war has, it must be agreed, made very difficult the question of preventive maintenance. The authors wished to state how very strongly they felt regarding the need for such preventive maintenance rather than regarding one's millwrights, electricians, etc., merely as a breakdown gang.

Desulphurisation with Basic Linings

In a supplementary note, the authors clarify their reference in the Paper to the question of desulphurisation. In the section on desulphurisation with basic linings, they conclude with the statement covered by figures in Table II to the effect that the desulphurisation achieved from the patched lining was only a little better than that obtained from the former type of lining used. Some prolonged trials showed that the results obtained with the material Dolopatch were quite as good as those given by the parent lining, and

in consequence the authors are quite unable to account for the rather freak results on which the statement referred to was based. The tests made did not show that Dolopatch is not as satisfactory as the original lining.

The authors also give the following figures obtained with Dolopatch patching on top of a Dolofer block lining on three days last July:—

July 14.	July 16.	July 19.
0.033	0.032	0.033
0.041	0.040	0.033
0.044	0.035	0.036
0.041	0.042	0.031
0.032	0.037	0.035
0.037	0.036	0.032
0.035	0.036	0.030
0.034	0.043	0.031
0.036	0.032	0.030
0.035	0.031	0.035
0.032	0.035	0.035
0.031	0.034	0.032
0.039	0.035	0.034
0.034	0.041	0.036
0.040	0.034	0.031
	0.036	0.037
	0.035	0.033
	0.037	
Av. 0.036	0.036	0.033

Further Discussion on Paper No. 775

MR. P. C. FASSOTTE wrote that Paper No. 775, which Messrs. Bolton and Hill have presented to the I.B.F., makes such good reading that he is tempted to make a few remarks. The authors state that it is desirable to fettle the nose of the converter, as otherwise the blast volume increases and determines a greater oxidation loss. Previously, however, they mentioned that the blower which is used is of the positive type. With such a blower the volume of air delivered is independent of back pressure and, consequently, the size of the nose cannot influence oxidation losses. They are correct, however, in stating that an over-sized nose tends to increase losses due to ejections. With a fan, the volumetric output is influenced by the amount of back pressure and, theoretically, a wider nose should lead to a greater admission of air in the converter; the difference, however, can only be small, and it is very doubtful whether this would affect oxidation losses to any extent.

A certain amount of confusion exists about this question of volumes and pressures used in conjunction with converters. The chemical reactions which take place in the vessel call for a large amount of oxygen and are intended to achieve the double purpose of eliminating certain elements and increasing the bath temperature. A metallic loss is incurred thereby, partly chemical and partly physical. The first is unavoidable, but the second is largely controllable.

As heat losses are a function of the duration of the blow, it is desirable to shorten the blow and concentrate the reactions in a short period. Incidentally, this favours economy of silicon. The total volume of air required by the blow should, therefore, be introduced in the converter in as short a time as possible. Obviously it is desirable to have a positive control over this input, and this is the great argument in favour of the positive blower. Such an equipment, provided it is of sufficient capacity, gives full control of the volume input, irrespective of frictional losses and back pressure.

Having this control of volume, the limiting factor of the speeding up of the operation becomes the physical metallic loss through projections. The amount of these projections is principally determined by the carrying capacity of the blast, which in turn is determined by the velocity of the blast, and this velocity is a function of the pressure at which the air is travelling at the exit of the tuyeres. It is only at the tuyere end of the air circuit between the blower and the converter that the final pressure can be altered and the velocity of the air influenced, since the frictional losses in the pipes can, for practical purposes, be considered as constant. Low pressures in the tuyeres mean low velocities and low projection losses. The design of the tuyeres, and particularly their total area, is the main factor governing the rate of air input practically possible, the duration of the operation and the amount of physical losses.

What induces these remarks is the figure of 12 per cent. which has been put forward as converter loss. The authors have, however, experienced, under certain conditions, a loss of 10 per cent. only. They obtained this by reducing their pressure, but as they at the same time reduced their volume, the operation lasted 20 min. He was not convinced that this produced steel of greater temperature; the opposite should have taken place, as the heat losses were bound to be greater with the longer operation. They have observed, however, that the metallic loss was smaller when using a low pressure and this was to be expected.

Probably the most severe criticism that is levelled against the side-blown converter is the high metallic loss entailed by the process. Scope for economy in this direction is vast indeed. The unavoidable loss is the weight of carbon, silicon and manganese in the iron. For the composition of iron mentioned by the authors this figure amounts to just over 5 per cent. The margin of possible economy in this case is, therefore, in the neighbourhood of 7 per cent. Part of this cannot be prevented on account of the law of mass, but a very substantial inroad can be made into this figure. In fact, plants are now in operation where the losses experienced in the converter have been brought remarkably close to the theoretical loss. These results have been obtained by a combination of plant design and converter practice, both based on a proper understanding of the interlocked factors of volume, pressure and velocity, and their influence on metallic loss.

Steelfoundry Problems

Authors' Reply

MR. L. W. BOLTON and MR. J. HILL, in a written reply to Mr. P. C. Fassotte, thanked him for his interest in the Paper and for his very useful comments. In the plant described, the blower delivers a positive and known volume of air to the converter for only a very small part of each heat. For a large proportion of the total blowing time, amounting to as much as 90 per cent. of some heats, the relief valve is opened to a greater or lesser degree because the use of the full air supply would cause too great a loss from ejection. In these circumstances, the conditions under which the air is supplied are similar to those obtaining when a high pressure fan is used, that is, an increased resistance in the vessel causes more air to pass through the relief valve and less into the conveter, and vice versa. In other words, in spite of the use of a positive blower, the back pressure in the vessel does influence the volume of air admitted.

Mr. Fassotte's suggestion that control should be maintained over volume input while still retaining the positive nature of the blast is noted with interest, and the authors agree that the provision of such equipment might be advantageous. They agree also with the remarks on tuyere size and its influence on air velocity and metal losses and intend to take an early opportunity of examining this further.

The metal losses experienced in the plant at present are admittedly on the high side, though in the opinion of the authors they cannot be considered in any way excessive under present conditions of operation. It is again stressed that the output from the plant is approximately 50 per cent. higher than that for which it was designed. It is believed that, if it were not necessary to obtain such rapid heats from the converter, losses could be reduced using the present design of vessel.

So far as the cupolas are concerned, the melting loss averages 6 to 7 per cent., which, again, may be a little higher than that obtained when melting similar mixtures in other works. On these furnaces, attempts have been made by increasing tuyere size and reducing blast velocity, to reduce oxidation, but the output required is extremely high for the size of cupola when melting high steel charges, and the steel scrap available is often of a light, bulky nature which it is difficult to melt rapidly while keeping oxidation losses low. Under existing conditions, it does not appear possible to improve very materially on the results from these furnaces.

In a later written reply to Mr. C. H. Kain's contribution, with reference to the question on the time allowed for air drying of the converter lining and its influence on subsequent lining life, Mr. Bolton gave the figures below in confirmation of the statement made by the authors that a drying time of seven to nine days is beneficial. It will be noted from data given in the Paper that the average life of a lining used after air drying for nine days is 122 heats. Shorter times than this have been allowed for drying from time to time using the same lining methods and materials, with the following results:—

Number of days lining air dried	Number of heats from lining	Average number of heats
5	127	118.7
5	141	
5	88	
4	134	111.7
4	90	
4	111	
3	101	88.7
3	84	
3	81	
2	61	66.3
2	66	
2	70	
2	70	
2	66	
2	65	

It is possible that drying time could be reduced, without any deleterious influence on life, if warm air were circulated inside the newly-lined vessel, but in the ordinary foundry atmosphere seven or more days' drying is necessary to obtain the most satisfactory results.

Paper No. 774

MR. W. T. BRUCE wrote in reference to Paper No. 774 that if, in the not very distant future, the X-ray examination of pressure castings is enforced by a clause inserted in the existing specifications, foundrymen and metallurgists would meet with problems which, compared with their present ones, would be like the proverbial mountains against the molehills.

REPORT ON COPPER-ANTIMONY-NICKEL GEAR ALLOY

(*Concluded from page* 72.)

as a guide to the behaviour of the alloy under particular service conditions. In regard to the question of gassing, there was no doubt that the main cause of this trouble would, in the first place, be due to the use of improper melting methods. It seemed evident, however, that if gassing of the copper-antimony-nickel alloy persisted even under correct melting conditions, then the cause of the trouble might be the presence of coal dust in the moulding sand. The effect of coal dust in this direction would, of course, be greater than a relatively inert carbonaceous material, which might be used as a mould facing, such as blacking or plumbago.

DESIGN OF A FRONT SLAGGING CUPOLA SPOUT

By R. D. PETCHER*

At the request of the A.F.A. Cupola Research Committee the author gives details of a front slagging spout which has been used very successfully for some time at the plant with which he is connected. Like most front slagging spouts, both the molten metal and slag are carried together through the cupola breast or tap hole into a trough. The metal then flows under a slag dam, while the slag floats on the metal and runs off at the side of the spout into a slag ladle. The clean metal then flows over the lip of the spout into a receiver from which it is distributed, by means of conventional transfer ladles, to the moulding floors.

The dimensions in Fig. 1 are those of the spout used on an 84 in. cupola shell lined to 66 in. It operates at approximately 18 oz. wind box pressure. This construction can be applied to any operation by proportioning it to suit a particular size cupola. The distance between the top of the cupola breast or tap hole and the lip of the slag spout is critical. If it is too low for the wind box pressure, air will bubble out of the tap hole, and if it is too great, the slag will not flow from the well of the cupola. The table of distance "X" and wind box pressure is taken from a paper by Reese.

It is the practice at the author's works to start melting with the cupola tap hole plugged. The slag spout drain hole is plugged with a round stock core. About 18 min. after "wind on," the cupola tap hole is opened and the metal flows continuously until the end of the heat. Melting can be stopped by simply shutting off the wind, and the slag spout will remain open for as long as 45 min. To shut down for longer periods, the slag spout drain hole should be opened, allowing the spout and cupola well to drain.

As the last iron in the stack melts, about 2,000 lb. of usable iron will remain in the cupola well and slag spout. This is tapped out by opening the cupola drain spout. When slag comes, the drain spout is lightly plugged. In due course, the cupola bottom is dropped, after which the front of the drain spout is unlatched and swung to one side. The whole spout system then drains free of molten iron and slag.

The cost of daily maintenance in labour and materials is about the same as that of a standard cupola spout. The slag is easily chipped out, holes are filled with the same grout mixture used to repair the cupola lining, and the spout is then washed with daubing clay and dried with either a torch or a wood fire. The whole spout, including the slag dam, is relined once in about 6 months. In the opinion of the works, the low maintenance is due to massive rigid construction and large holes and passages that are easily cleaned. The spout is made of cast iron sections of ¼- to 1-in. thickness, is very rigidly supported by the cupola frame at one end and is rigidly suspended from a steel building truss at the other end. Heavy lateral tie rods at the front end prevent side sway.

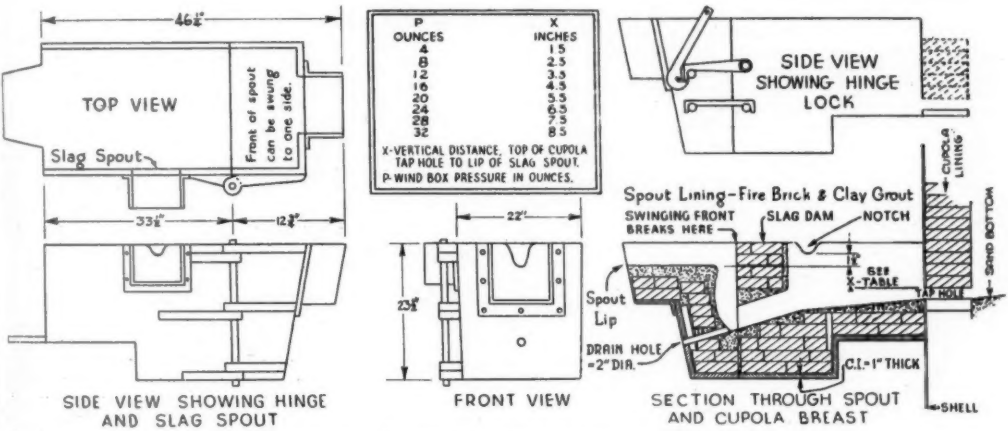


FIG. 1.—SECTION DRAWING OF FRONT SLAGGING CUPOLA SPOUT.

* Paper read at the St. Louis Meeting of the American Foundrymen's Association; the author is foundry superintendent, Manufacturing Div., Weil-McLain Co.

Illuminating Gas for Cupolas.—D. TINBERGEN, in "Gasbelangen" (1942, No. 3, 19-21), describes a device for heating up cupolas with illuminating gas.

FIELD TESTS ON ATMOSPHERIC CORROSION

Paper No. 10—1943 of the Corrosion Committee of the Iron and Steel Institute, entitled "Present Position of the Corrosion Committee's Field Tests on Atmospheric Corrosion (Unpainted Specimens)," by J. C. Hudson, D.Sc. (Official Investigator), brings up to date the information given in earlier Reports of the Committee concerning atmospheric corrosion tests made on ordinary ferrous materials of construction, including wrought irons, ingot irons and steels both of ordinary and of the low-alloy type. The main tests were made at fourteen stations, seven at home and seven overseas, representing marine, rural, industrial, tropical and arctic conditions. The specimens measured 15 by 10 by ¼ in., and were exposed vertically.

Comparison of the corrosive effects of different atmospheres indicates that the primary cause of serious corrosion of ferrous materials is pollution of the air with sulphur gases. The maximum rate of corrosion observed for ordinary mild steel over a five years' period was 0.0042 in. per year in the industrial atmosphere of Sheffield. Much lower rates were recorded at most overseas stations. The corrosion rate probably decreases with increasing time of exposure. Wrought irons containing much slag are more resistant to atmospheric corrosion than mild steel, but those with low slag contents are more corrodible. Ingot iron resists general corrosion to much the same extent as mild steel, but Aston-Byers iron (made by mixing a synthetic slag with a heat of dead-mild steel) is slightly more corrodible.

Concerning low-percentage alloy additions, copper is beneficial when the steel is exposed in the open air, but not in enclosed atmospheres (railway tunnels, etc.). Chromium, silicon, nickel and probably arsenic all improve the corrosion resistance. In general, the surface condition in which the specimens are exposed has little influence on the relative results for different materials, except that in the case of certain wrought irons with mill scales that are particularly resistant to weathering, abnormal results may be obtained for specimens exposed in the as-rolled condition, owing to the accumulation of rust between the scale and the metal which leads to local corrosion. Machined surfaces corrode more than sand-blasted ones.

To ensure complete scale removal, by weathering, from ¼-in. plates of ordinary mild steel, exposure for about one year is necessary in Britain; under the milder conditions overseas descaling may be incomplete after five years' exposure. Copper in the steel does not affect the descaling period. The method of piling employed in making wrought irons has little effect on their resistance to corrosion, except that re-rolling the puddled bars causes a marked improvement, which may be attributed to the consolidation of the surface. Further reworking has little effect.

The rate of atmospheric corrosion varies with the height above ground-level, but is also governed by local conditions. Horizontal surfaces corrode more

(*Continued at foot of next column.*)

SAND UNDER THE MOVIE CAMERA

The behaviour of mould and core surfaces at the elevated temperatures of casting is visually demonstrated in a unique coloured motion picture which has been produced by Harry W. Dietert, Detroit. The film has been shown at several American foundrymen's meetings and has attracted favourable comment. Judging from reports, this film would also be of deep interest to British foundrymen, who have themselves devoted much research to a host of sand problems.

The use of motion technique in this film to show the entire cycle of testing operations makes it possible to slow these down and study them in detail. Intense study of this sort is intended not so much to bring out new conceptions of what happens during casting as to develop unified agreement on the steps in the cycle. This combination of colour and slow speed, coupled with arrangements whereby elevated temperature tests were taken through a port in the furnace to show the behaviour of the sand throughout the entire tests provides an unusually clear idea of exactly how a sand behaves under high temperatures.

Conclusions which can be drawn from inspection of this film are extremely interesting. Spalling, for example, appears to be the result of a number of factors, such as unequal volume change of sand or core sectional areas, low ductility of sand or core surfaces making it unable to accommodate the hot expansion or hot shrinkage, large differences in hardness or adjacent areas or in the rate of heating of two such areas, or a lack of void spaces between sand grains to allow for growth of the grains.

Similarly, spalling can be reduced by arranging to secure equal volume change of adjacent sectional areas by providing sufficient hot permeability or by greater equality in heat input, hot deformation, hot strength and hardness. Using material with available void spaces is helpful, as is the obtaining of a surface possessing hot deformation which avoids lack of ductility.

The film seems to provide the lesson that collapsibility is the result of the oxidation of the binders, or of a composition change of the binder to a non-binding material. Hot strength appears to result from the pyro-strength of the binder, a composition change of the binder to some stable ceramic material at elevated temperatures, or the melting of one or more materials to form a viscous liquid at elevated temperatures.

(*Continued from previous column.*)

than vertical ones, probably because rain water lingers on them and they remain wet longer. Hot-galvanised mild-steel specimens exposed in a rural atmosphere in Wales showed little sign of deterioration of the zinc coating after eleven years. The probable lives of galvanised coatings are calculated on the basis of test results obtained on zinc specimens exposed at the corrosion stations. For equivalent corrosion resistance there is a marked difference between the gauges of galvanised and black plates; the latter need to be appreciably thicker.

REPORT ON COPPER-ANTIMONY-NICKEL GEAR ALLOY

FURTHER RESULTS OF CORROSION AND WEAR TESTS

Discussion of Report at Institute's Annual Conference adds more test data on wear, etc.

The Non-Ferrous Technical Session organised in connection with the Annual Conference of the Institute of British Foundrymen, over which Mr. D. Howard Wood presided, had before it as the first Paper for discussion the "Report on Copper-Antimony-Nickel Gear Alloy," prepared by the Non-Ferrous Sub-Committee.

Authors' Introductory Remarks

MR. F. HUDSON, who presented the Report, drew attention to one or two corrections in the preprint. Figs. 1 and 2 should be transposed. At the bottom of Table II there should be a footnote, "See Table III for analysis." On page 7 of the preprint in the second column, 7th line down, "(10 per cent.)" should read "(10 per cent. P)." On page 13, and in the table on p. 14, the words "sodium thiosulphate" should read "sodium hydrosulphite" in every case.

Continuing, he said the work done in this Report was started on behalf of the Admiralty, following information from Canada on the development of a new type of gear material containing 7 to 8 per cent. of antimony, 1.5 per cent. to 2.5 per cent. of nickel and the balance copper. It had been claimed that this alloy was considerably better than the ordinary tin bronzes for gear application, and the Admiralty felt that, if such was the case, it might be used in connection with the national effort. The intention of the Non-Ferrous Sub-Committee of the Technical Committee was therefore to make a Report to guide the Admiralty in two directions, (1) giving production data and how the alloy would behave in the foundry, and (2) to give, if possible, some indication as to the value of the alloy in service. This Report primarily covered the first aspect of this work, *viz.*, the behaviour of the material in the foundry. A foreword had been added giving an indication of the available literature which had been published, and this mainly hinged round the constitutional diagram. Mr. Hudson then briefly summarised the general conclusions arrived at as set out in the Report.

In the course of further remarks, he said it had been hoped at this meeting to give some additional information as to the results of service tests, but in some cases these results had been delayed and all the data being collected were not yet available. However, he hoped that some of the investigators who had been engaged in this work might be able to say something following further tests that they might have made in their works. In conclusion, he thanked those who had collaborated in this work for their great assistance and for the willingness with which they had come forward in a very difficult time to conduct tests on this new material.

Wear Tests Unconvincing

MR. J. ARNOTT said there were two questions which arose with regard to this new alloy. The first was as to how the alloy behaved in the foundry. It had been found that the alloy responded to known treatment. The first melt was slightly unsound, but an oxidising treatment of the usual type applied to the bronzes gave reasonable soundness. The tests were in the 10-ton region so far as tensile was concerned, but it had been possible to get 14 tons. Generally speaking, however, this was a 10-ton alloy in the average sand-cast condition. As to usefulness, his firm did not make gear bronzes, but they had many applications in which economy in tin might have been of use. They therefore submitted pieces of the material to friction tests on a wear-testing machine which they had used for something like 20 years, and the conclusion reached was that this material was not as suitable as a leaded bronze under the conditions they were familiar with, as set out in the Report. Possibly that was an unfair comparison, because this new material was non-leaded, and it had been found, without exception, that a leaded alloy, under equal conditions, was better than a non-leaded alloy. Apart from that, they had no way of assessing its value as a bearing bronze. However, the supply position was not so favourable as it might be, and it seemed that it would be as difficult to get antimony as tin. Therefore, on the whole, from his own angle, this material, as a substitute for the tin-bronzes, did not appear to warrant a change.

Oxidising Atmosphere Needed

MR. E. J. L. HOWARD said that Mr. Brown and himself carried out these tests to ascertain the founding properties, and what value the alloy would have, apart from gears, in general engineering practice. The foundry investigation showed that the alloy was prone to gas absorption, and this took place in both virgin metal and in re-melted metal. It could, however, be largely overcome by suitable melting conditions, *i.e.*, to melt in a strongly oxidising atmosphere, and reduce with phosphor-copper prior to pouring and casting at the correct temperature, which seemed to lie between 1,100 and 1,200 deg. C., depending on the nature of the castings. It was noticed that a very definite change took place in the metal at about 1,100 deg. C. It became heavily crusted, and this had to be broken away before pouring could take place. The metal was then very fluid and ran well, and there seemed no reason at all why normal bronze founding methods should not be adopted. The physical properties of the metal seemed to be rather lower than in the case

Report on Cu-Sb-Ni Alloy

of materials usually employed for gears which called for a minimum of 14 tons, an elongation of 7 per cent., and a Brinell hardness of 69. The casting temperature did not affect to any marked degree the ultimate tensile, the yield point, elongation or Izod figures, but, of course, it affected the hardness. (Mr. Howard then summarised the section of the Report "Tin-free Gear Bronzes" contributed by himself and Mr. Brown.)

The other investigators also briefly introduced their sections of the Report. In the course of his introductory remarks, MR. A. DUNLOP also referred to the results obtained in corrosion tests with this alloy in his laboratory. It could be concluded from these tests that: (1) On the basis of the loss in weight in immersion tests under laboratory conditions, followed by chemical cleaning, the Sb-Ni-Cu alloys appeared somewhat less resistant to corrosion than tin-bronze. Except in stagnant sea water, the corrosion resistance was increased by the addition of zinc. (2) In aerated or stagnant tap water, or stagnant sea water, in the absence of abrasion, the Sb-bearing alloys would be expected satisfactorily to replace tin-bronze, but in freely-aerated sea water the loss in weight would be greater. (3) The Sb-containing alloys owe their corrosion resistance largely to semi-protective films, which are not as resistant to abrasion as those formed by tin-bronze. The alloys might not, therefore, be satisfactory where corrosion and abrasion occur together.

Discussion of Report

MR. C. COLDRON SMITH (E.-in.-C. Dept., Admiralty) expressed the view that the Report, with its seven contributions, illustrated a method of attack on a problem which might more often be followed in investigations of this kind because of the rapidity in obtaining reliable results. The Report was noteworthy in that the different contributions were in general agreement with one another. In the editing of Dr. Walpole's contribution he thought that there was an oversight in not relating it to the thermal equilibrium diagram which Dr. Walpole must have had in mind and which was presumably the Hansen diagram as shown in Fig. 2 (in the preprint, now corrected to Fig. 1).

He disliked the use of the word "phase" as applied to the micro-constituents of these cast alloys, which were obviously not in thermal equilibrium. The words "constituent" or "micro-constituent" were preferable. Apart from these small points he would have liked to have heard from those who did the foundry work what melting loss occurred with the antimony. He assumed that it must have been small, otherwise attention would have been drawn to it. In view of the rather poisonous nature of antimony vapour and of its oxides, perhaps a word of warning might not be out of place.

The wear tests mentioned by Mr. Arnott were of exceptional interest in view of Mr. Arnott's long experience with this method of testing, but it was not stated whether these tests were carried out with the alloy in the aged condition or in the as-cast condition. There was one aspect of the wear problem that would have to be looked into, and that was the corrodibility of the alloy on exposure to hot oil and air. Many people knew that some successful attempts had been made to arrange the various bearing alloys in an order of merit in regard to corrodibility under these conditions. The behaviour of copper-nickel antimony alloys in comparison with the tin bronzes would need to be ascertained by some such corrosion test.

Blowhole Formation

MR. W. A. BAKER, B.Sc., said it was striking that all the investigators agreed that the physical properties of the material were rather poor in the sand-cast condition. Although the Report indicated that chilling of centrifugal casting gave substantially better results it followed that the new material suffered from a serious limitation in its application. In the introduction to the Report there was an implication that the main interest in this material was as a substitute for gunmetal, emphasis being laid on the absence of tin from the alloy. That was a point upon which he would like to comment. In a previous report of the sub-committee on low tin and tin-free bronzes it was considered that silicon bronzes did not offer very much promise as a substitute, one reason put forward being the high copper content. That, of course, applied equally to this antimony alloy. It was gathered from what had been said by another speaker that antimony was also in short supply, which obviously made the position somewhat worse.

Continuing, Mr. Baker said his main purpose in speaking was to give the results of a few tests carried out by the British Non-Ferrous Research Association at Mr. Hudson's instigation. Some tests were carried out to determine the cause of the porosity encountered by various investigators, as stated in the Report, and he was given to understand that the porosity occurred in the foundry when the metal was melted under reducing conditions, and particularly when the melting temperature was high. There was also a suggestion that the presence of coal dust in the moulding sand was a contributory cause. Only a few tests were made by the B.N.F.M.R.A., but the results confirmed the general finding that an oxidising atmosphere yielded castings free from gas porosity, and that a reducing atmosphere, particularly when the metal was overheated, introduced considerable quantities of gas. However, in these tests the castings did not contain any of the sub-surface blowholes mentioned in the Report. The porosity was very widely dispersed, and there were very small cavities not visible to the naked eye, but visible under a microscope. The matter was pursued further in an attempt to produce large blowholes. It had been suggested that carbon monoxide was a possible source of these blowholes, the reason being that in an earlier investigation it had been found that a material subject to carbon monoxide gas unsoundness sometimes evolved gas very freely early in freezing, and gave large blowholes near the surface. To check this, the antimony alloy was melted in a high frequency furnace in an atmosphere of air, and under

these oxidising conditions sound castings were obtained. Then the charge was covered with charcoal and allowed to stand, and at intervals further small castings were poured. As the holding time under the charcoal increased small dispersed cavities first appeared, and later the large sub-surface blowholes mentioned in the Report were obtained. When the charcoal cover was removed and castings were poured at intervals, the melt passed through the opposite cycle. The large blowholes disappeared, leaving smaller cavities visible only under the microscope. Finally, when the material was thoroughly oxidised it was substantially free from gas porosity. These results were by no means conclusive, but, in his view, they suggested that carbon monoxide was a possible cause of this trouble. In any case, it was clear that contact with charcoal should be avoided as far as possible.

Effect of Coal Dust in Sand

A further test was made to try and confirm the suggestion that coal dust in the sand caused the trouble. Moulds were made from Mansfield sand, some being covered with a black wash, and material melted in an oxidising atmosphere was poured into them, but no porosity was observed. Thus, his observations were not quite in line with the suggestion in the paper that carbon in the mould was the source of the trouble.

A few tests on the corrosion resistance of this material were made, and again he emphasised that only a very few tests were made and that the results were only indicative. Two types of test were carried out. In one case, samples were exposed to corrosion under impingement conditions in sea water, and in the other case they were exposed to static immersion in sea water. In each case the antimony-nickel bronze was compared with 88:10:2 gunmetal, and an 86:7:5:2 alloy. Under impingement conditions, (*i.e.*, sea water moving at 15 ft. per sec. and carrying 3 per cent. entangled air), the antimony alloy showed serious attack in only 8 days. There was considerable shallow pitting at the point of impingement and a considerable etching of the material and from the B.N.F.M.R.A.'s experience of other non-ferrous metals of proved behaviour, and from the check tests on the two gunmetals, it seemed fairly certain that the antimony bronze would fail rapidly under impingement conditions. The two gunmetals were run for 14 days, and still showed little signs of attack. Under static immersion conditions, the antimony bronze was substantially similar to the tin-bronzes. Although the differences were very slight, the antimony bronze, if anything, was the most resistant of the three and the 86:7:5:2 was the least resistant of the three.

Coal Dust in Moulds for N.F. Castings

MR. A. DUNLOP (one of the investigators), referring to the point made by Mr. Baker as to the effect of carbonaceous material in the mould, said that the tests he had been responsible for were with moulding sand containing 3 to 4 per cent. of coal dust—not just a dressing. The castings poured into the moulds were comparatively massive, so that the sand was pretty well heated all over and gas was liberated before the alloy completely solidified. In all his tests the metal was melted under oxidising conditions and the results were obtained with a heavy casting, say of 2- to 3-in. section and 8 in. long. In the case of castings without chills, there was "spewing," but excess metal poured into an iron ingot-mould sunk well. Successful casting had been carried out with coal dust in the sand, with castings of ¾- to 1-in. dia.

In reply to a comment by Mr. Dunlop, MR. BAKER remarked that he should have amplified his previous remarks. His casting was 2 in. dia. and 2 in. high, and the rate of cooling was not very fast. One of the points which he noted in reading the Paper was that the blowhole porosity was observed in castings made in sand containing coal dust, but the fact that no porosity was observed when separate melts were cast into other moulds was not quite so convincing as it might be. He suggested that the same metal should have been poured into sand moulds with and without coal dust.

MR. DUNLOP said it was the same melt.

MR. BAKER said that was not indicated in the Paper, and it should be made clear. If he remembered rightly, no further trouble was experienced when the coal dust was eliminated. However, Mr. Dunlop and himself had one point in common, and that was that the presence of carbon was undesirable.

MR. PYM, referring to the use of coal dust, said his firm had been specialising in bronze for some years and had never used coal dust. They hoped they had solved the problem by using wheaten flour mixed with the sand. They made high-pressure castings and had brought down the amount of scrap to less than 0.01 per cent.

Wear Tests

MR. HOLLIGAN, speaking of wear tests, said he appreciated that there had not been very much time for service tests. Mr. Arnott mentioned tests in which the material had been run against similar material and also against phosphor bronze. What results, if any, had been obtained when running the copper-antimony-nickel alloy against soft and hard steel respectively? Mr. Arnott had mentioned hard steel, but had anything been done with soft steel, lubricated and unlubricated?

MR. ARNOTT replied that in the majority of gear applications, moderately hard steel was used, but he could not answer Mr. Holligan's question because he had not been concerned with gear applications.

MR. PEAKE, also speaking with regard to wear tests, said he understood there were still one or two tests outstanding, but the great point of interest to him was whether this alloy would give exceptional wear resistance for gearwheels, worms, etc. Was it to be taken that at some subsequent date, when further tests had been completed, that the members of the Institute would be informed?

The CHAIRMAN said that the results of further tests would be published probably with this Report, together with the discussion upon it.

MR. HUDSON, in a brief general reply to

Report on Cu-Sb-Ni Alloy

the discussion, took Mr. Coldron-Smith's point as to loss of antimony in melting, and said he did not think there was much loss and he did not think there was much fear of poisonous fumes being given off, although not quite enough was known about that point yet. Mr. Arnott's wear tests were carried out with the alloy in the as-cast condition, and not heat-treated. He agreed with Mr. Coldron-Smith as to the desirability of assessing the corrodibility of this alloy in oil, and much more work might be done in that direction. So far, however, none had been done. He thanked Mr. Baker for his very interesting, collaborative, and constructive remarks and added that the sub-committee was much indebted to the British Non-Ferrous Metals Research Association for their assistance. The results of the outstanding service tests would be made known, as the Chairman had said. At the moment there were several outstanding tests. For example, Messrs. Holroyd were conducting actual tests on gears, and the results should clear up the question of service properties of this alloy. The main issue was that if this new alloy did not show a considerable superiority as a gear material over the existing tin-bronzes, in view of the supply position the sub-committee felt that no change was warranted. Everything hinged on the actual service results obtained, and these would definitely be published with the discussion and Paper later on.

Vote of Thanks

MR. L. G. BERESFORD, proposing a vote of thanks to the authors of the various Papers contained in the Report, said this was one of the finest examples of international co-operation. It had started with a Canadian firm, who handed on their results to British foundrymen, and the sub-committee had made a very good job of the work they had undertaken.

MR. HOLLIGAN, in seconding, asked whether we had information as to the experience of the Hamilton Gear Company with gears made of this material. The vote of thanks was cordially given.

MR. HUDSON said that a copy of this Report was to be sent to Canada with a covering letter asking for the information Mr. Holligan had mentioned.

WRITTEN ADDENDUM

MR. E. J. L. HOWARD later wrote that tests had been made to ascertain the effect of running sleeves and bushes made of copper-antimony-nickel alloy with water lubrication under a heavy load. For the purpose of the test a sleeve was mounted on a shaft and rotated at 1,500 revs. per min. A stationary loaded bush was located around the sleeve with a diametral clearance of 12 mils between the two. The weight of the bush and its mountings was 91 lbs. plus an additional load of 400 lbs., making the total of 491 lbs. Undue wear was indicated by the power to drive fluctuating from relatively low values to high values, measured with an ammeter. The results obtained were as follows:—

Sleeve material.	Bush material.	Brinell hardness.		Result 491 lbs. load.	Ammeter reading.
		Sleeve.	Bush.		
Copper-nickel-antimony	Copper-nickel-antimony ..	76	76	Seized	5—15
Leaded phosphor bronze	Ditto	58	73	Good	1—2
Phosphor bronze ..	Ditto	64	72	Fair	2—10

These tests indicate the metal would run with phosphor bronze or a leaded phosphor bronze without any tendency to seize. The tests made with the sleeve and bush of the copper-antimony-nickel alloy showed seizure to occur.

Some corrosion tests were also conducted under static conditions at room temperatures against weak acids, sea water and acid salts. These indicate that taken all round the alloy is equal to phosphor bronze and leaded phosphor bronze of the following composition:—

	Phosphor bronze.	Leaded phosphor bronze.
	Per cent.	Per cent.
Copper	92.0	84.0
Tin	7.5	7.5
Phosphorus	0.5	0.5
Lead	Nil	8.0

It was noted that the Hamilton Gear Company claimed higher physical properties than had been obtained here, and that no advantage was obtained by chilling. This did not agree with their experience.

The method of making this alloy suggested by Mr. Hyslop and Mr. R. F. Hudson, by having a small amount of zinc present in the charge, was quite good and certainly did tend to overcome the troubles due to gassing.

He did not follow Mr. Dunlop and Mr. Frank Hudson's claim that the gassing might be due to coal dust in the moulding sand. It might contribute to the defect, but he felt sure the root of the trouble was in the melting of the alloy and casting temperature, and that by the adoption of the correct procedure it might be overcome.

MR. F. HUDSON, in reply, wrote that the running tests, outlined by Mr. Howard, on the copper-antimony-nickel alloy under water lubrication were of considerable interest, and would be extremely useful

(*Concluded on page* 66.)

RADIOGRAPHY OF MAGNESIUM CASTINGS

In an article in "Industrial Radiography," R. G. Cron deals with various aspects of the industrial radiography of magnesium castings. The use of low voltages, short exposures, and small focal spot tubes, coupled with the predominance of light sections, makes it possible to secure high contrast and good definition in radiographs of these castings, he points out. It is important that density and contrast should be not only good, but also consistent at all times. Uniform density and contrast enable the observer to judge whether the degree of microshrinkage present in a casting justifies its rejection. Close control of the developer is essential to maintaining uniform density. A convenient way to check the degree of exhaustion is by comparing radiographs of a step bar made with identical exposures. A coarse-grained structure is revealed by a mottled appearance of the radiograph. Cold sheets and oxide skins are somewhat difficult to detect. Gross defects, such as blows and shrinkage cavities, are readily detected. Failure to remove core wires is readily disclosed by radiographs. The number of castings from any one lot which should be X-rayed depends upon how consistently the quality of castings is maintained, rather than on the particular quality. Defects should be discovered, but it is even more important that their cause should be determined. Defects in an individual casting should not constitute grounds for rejection of an entire lot. The first casting of a heat might exhibit excessive microshrinkage as the result of too much superheat, whereas the last casting poured from the same heat might contain a misrun caused by too low temperature. The determining factor for the rejection of an entire lot should be the production technique of the lot.

CANADIAN ALUMINIUM

With American assistance, Canada has built up a substantial aluminium industry. Canadian aluminium works are now producing at an annual rate of 503,000 tons. In 1942 production totalled 335,800 tons; in 1939 it was not more than 75,000 tons. The present annual rate exceeds the production of the whole world in 1937 and is not far behind the world figure for 1939. The marked rise in Canada's production is of particular importance to the United Kingdom, which for a long time past has drawn the bulk of its aluminium from the Dominion. A substantial part of Canada's production still goes to the United States, but soon the latter, through its own programme of expansion, will be self-sufficient in aluminium; and as Canada itself cannot use more than a limited part of its output, the Dominion will greatly need the United Kingdom market after the war. The Canadian industry is under the control of one monopoly company, Aluminium, Limited.

OBITUARY

MR. GILBERT WILLIAM WOTHERSPOON, who died in London recently, was proprietor of the firm of Hugh Martin & Company, Limited, iron merchants, of Glasgow.

MR. CHARLES T. HAVART, joint governing director of F. S. Dudgeon & Havart, Limited, engineers' merchants and agents, of London, died on September 10. He was 71 years of age.

MR. WILLIAM HAY HOWDEN, a director of James Howden & Company, Limited, engineers, of Glasgow, and of their associated companies, died on Saturday, September 11. He was 59. Mr. Howden was well known in engineering circles in this country and on the Continent.

MAJOR WILLIAM WALKER MACPHERSON, a former managing director of Fairbairn Lawson Combe Barbour, Limited, Wellington Foundry, Leeds, has died at the age of 76. He succeeded his father as managing director of the Wellington Foundry branch of the company in 1902. After retiring in 1911, he devoted his energies to public work.

MR. WILLIAM LLOYD BAYLEY, who since 1919 had been general manager of the Darlaston works of Guest, Keen & Nettlefolds, Limited, died at Wednesbury recently. A native of Horsehay, Mr. Bayley was apprenticed to general engineering with the Coalbrookdale Company, Limited. Later he worked at Sheffield and for the Lilleshall Company, Limited. He went to Darlaston as works manager of S. W. Cotterill, Limited. He was deputy chairman, a member of the Central Council and a trustee of the Black Bolt and Nut Association of Great Britain; and a member of the general committee of the Bright Bolt and Nut Manufacturers' Association.

PERSONAL

MR. RICHARD BUXTON has accepted the invitation of the Bilston Town Council to be Mayor of the Borough for the coming municipal year. Mr. Buxton is the senior partner in the firm of R. & A. Buxton, engineers, of Bradley, Bilston.

MR. J. W. WARRINGTON, general manager of the Exactor Control Company, Limited, makers of hydraulic controls, has been appointed a director of that company. He was formerly chief engineer of the Glacier Metal Company, Limited.

VISCOUNT WEIR, chairman of G. & J. Weir, Limited, Holm Foundry, Cathcart, Glasgow, celebrated the fiftieth anniversary of his joining the firm by giving £10,000 to the fracture clinic of the Victoria Infirmary, Glasgow. Five years ago Lord Weir established the clinic by giving £7,000, and his latest contribution is intended to develop and extend the work. The intimation was made at a social gathering on September 10, when Lord Weir was met by representatives of the management and staff, and received the firm's long-service certificate and presentations from the employees.

NEWS IN BRIEF

SIR FRANCIS JOSEPH has accepted an invitation to be the first honorary president of the National Society of Caterers to Industry.

THE FOUNDRY WORKERS' UNION, the Scottish Brass Moulders' Union, and the Association of Iron, Steel and Brass Dressers of Scotland are to amalgamate. Ballots of the unions have resulted in large majorities in favour of the merger.

A JOINT MEETING of the Sheffield Metallurgical Association and the Sheffield Society of Engineers and Metallurgists will be held at the Royal Victoria Station Hotel, Sheffield, on Tuesday, September 28, at 6 p.m. Professor Sir Lawrence Bragg, F.R.S., will speak on "The Strength of Metals."

THE OXLEY ENGINEERING COMPANY, LIMITED, proposes to increase the share capital by £100,000 to £200,000 by the creation of 400,000 ordinary shares of 5s. The increased capital, it is stated, "will be available in connection with the acquisition of any business which the directors consider can with advantage be amalgamated with the business of the company."

THE PARTNERSHIP between Harold Ellor, Spencer Johnson and Willie Russell, carrying on business as brassfounders and finishers at Waterloo Street, Oldham, under the style of ELLOR, JOHNSON & RUSSELL, has been dissolved by reason of the death of Mr. Willie Russell. Debts will be received and paid respectively by the remaining partners, who are continuing the business under the same style.

THE RESEARCH COMMITTEE of the British Hard Coke Association visited the Kingston and Fulham Laboratories of the British Coal Utilisation Research Association on September 9 to inspect the establishment and to learn of the actual work in progress, which was explained by Mr. J. G. Bennett, the director. It was hoped that, by this means, there would be no overlapping by the two bodies, and that their work would be co-operative rather than competitive.

MR. E. M. GOLLANCE, at a meeting of the Council of the National Association of Non-Ferrous Scrap Metal Merchants at Sheffield last week, expressed the opinion that further control and direction of industry by the State and other corporate bodies was individual trader would ever return to that unrestricted probable. It was extremely unlikely, he said, that the freedom of action which before the war had played such a great part in their history. The association must be strong enough to make its influence felt for the benefit of the industry.

A PERMANENT EXHIBITION, to be known as the Works Relations Centre, has been opened at the Birmingham headquarters of the Ministry of Supply in Great Charles Street. It puts on record the internal publicity methods now used in many important war plants. The exhibition has been sponsored by the Industrial Publicity Committee of the Regional Board, and has been erected by the Ministry of Supply on behalf of all the production departments and the Ministry of Information. It is planned to show the various services available from each of them.

PRESIDING AT THE ANNUAL MEETING of Barton & Sons, Limited, Mr. J. E. Hodgkin (chairman) said that they were now a holding company with 100 per cent. interest in seven operative businesses in various parts of the country. These businesses were all of an engineering character and included the manufacture of electrically welded tubing and precision tubing, with fittings; the production of a comprehensive range of forgings by drop hammers and horizontal forging presses; bolts and nuts of considerable variety; structural steel buildings, including bridges; pre-fabricated parts for ships; various types of aluminium, alloy, and other high-quality non-ferrous castings, and abrasive shot and grit.

PROPOSALS FOR TRAINING young engineers to assist the rehabilitation of industrial life and the recovery of export trade are made by the Institution of Mechanical Engineers in a statement commenting on the recent educational reconstruction White Paper issued by the Board of Education. The Institution welcomes the White Paper and suggests that an advisory council on engineering education and training should be set up. The council would constitute part of a permanent board for technical education. Better facilities for technical education should be obligatory, says the Institution, and any reorganisation of higher technical education must cover fully the work of technical colleges and universities.

ON THE BUYING PERMITS necessary for the purchase of industrial rubber and safety boots information is printed giving the number of coupons which must be surrendered for each type. The changes made by the Consumer Rationing (No. 21) Order (S.R. & O. 1943, No. 1099) mean that the information is now out of date. The correct number of coupons which must be surrendered with buying permits is now: With IF/1 permits (for rubber boots of knee length or more), 6; with IF/2 permits (for rubber boots of ankle length or with textile leg), 3; with IF/3 permits (for industrial safety boots), 6., Existing permits, which remain valid, will continue to be used until supplies are exhausted.

THE WORD "OUTWORKING," in its sense of work done outside the shop or factory, dates, according to the Oxford English Dictionary, from the end of the 18th century. It has come back into prominent use during the last two years to describe a system by which people, whose age, domestic ties or other obligations prevent them from working in factories, can yet be given the opportunity to utilise their services in war production. The latest figures show that there are some 20,000 outworkers in Britain at the present time, which means that, thanks to them, some thousands of full-time workers, previously engaged on the jobs which are now being outworked, have been freed to fill outstanding vacancies for work which can only be done in the factory. The Ministry of Production has just issued a brochure describing different types of outworking schemes throughout the country and explaining how to organise them.

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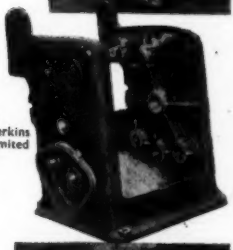
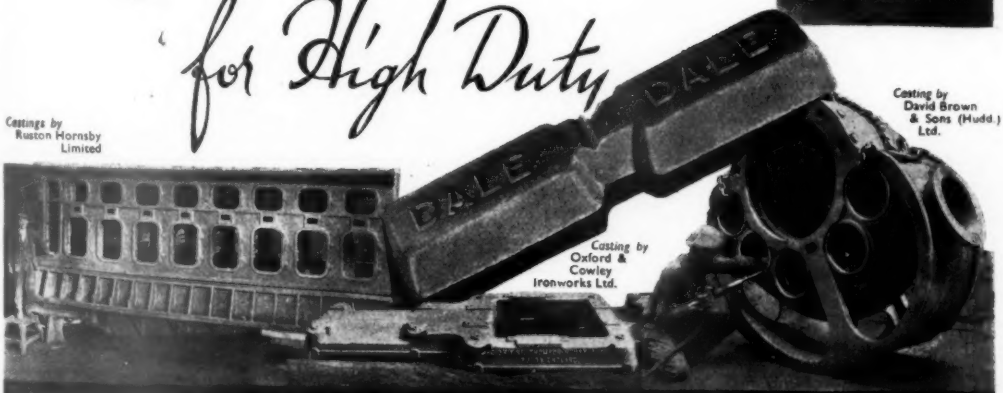
Castings by Morris Motors Limited.



Casting by Baker Perkins Limited

Castings by Ruston Hornsby Limited



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Casting by Oxford & Cowley Ironworks Ltd.

THE STANTON IRONWORKS COMPANY LIMITED
NEAR NOTTINGHAM.

COMPANY RESULTS

(Figures for previous year in brackets)

A. Reyrolle—Interim dividend of 5% (same).

Halesowen Steel—Interim dividend of 7½% (same).

Glover & Main—Interim ordinary dividend of 5% (4%).

Coltness Iron—Interim dividend of 9d. per 15s. share (same).

Lancashire Dynamo & Crypto—Interim dividend of 5% (same).

British Aluminium—Interim dividend of 3% (same) on the ordinary stock.

Breedon & Cloud Hill Lime Works—Interim dividend of 7½% (same).

Stothert & Pitt—Dividend on the ordinary shares of 10% and a bonus of 2½%.

Fodens—Net profit for the year to May 31 last, £32,116 (£30,182); dividend of 8% (same).

United Gas Industries—Final ordinary dividend of 7% (same) and a bonus of 3% (nil), making 15% (12%).

Richard Johnson Clapham & Morris—Final ordinary dividend of 11¼%, making 15% (same), and a final participating preference dividend of 1%, making 7% (same).

Brightside Foundry & Engineering—Net profit for the year to June 30, after taxation, £75,246 (£72,633); to general reserve, £25,000; ordinary dividend of 35% (25%); forward, £90,816 (£72,445).

Vaughan Bros. (Drop-Forgings)—Profit for the year to June 30, after depreciation and E.P.T., £42,099 (£44,217); income tax, £22,507 (£27,118); final dividend of 10%, making 20% (same); forward, £16,595 (£13,730).

Oxley Engineering—Trading profit to June 30 last, £23,905 (£76,102); tax provision, £7,417 (£57,108); net profit, £12,271 (£14,034); dividend of 15% (12½%), £7,500 (£6,250); general reserve, £5,000 (£4,000); forward, £6,580 (£6,809).

A. & J. Main—Profit for 1942, after charging depreciation and providing for taxation, £30,884 (£21,261); dividend of 6½% on the cumulative preference shares, £4,463 (same); to general reserve, £17,500 (£10,000); dividend of 10% on the ordinary shares, £6,482 (same); forward, £8,735 (£6,296).

W. H. Dorman & Company—Net profit for the year to March 31, after charging interest, depreciation, pension scheme, etc., £78,347 (£78,495); dividend on 11% preference shares, £6,875 (same); taxation, £69,000 (£61,833); to reserve, nil (£7,000); dividend of 16¾% on the ordinary shares, £2,458 (same); forward, £7,438 (£7,424).

THE COMMISSIONERS OF CUSTOMS AND EXCISE have further considered the liability to purchase tax of mantels and surrounds which are supplied together with fire parts, and have decided that such mantels and surrounds, whether of tiles, metal or other material, will not in future be regarded as chargeable provided that they are physically separate from the fire parts.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

W. H. Hooper (Metal Brokers), 30, South Parade, Halifax—£1,000. W. H. and E. Hooper, W. Blades and M. Wilkinson.

David Barbour (Chromium), 986, Pollokshaws Road, Glasgow—£5,000. Platers in chrome, nickel, etc. G. T. and L. M. Glen.

H. J. Creese & Sons—Iron, steel and metal founders, etc. £5,000. H. J. Creese, 162, Cardinal's Walk, Leicester, and R. Creese.

Edsons (Birmingham), 15, River Street, Balsall Heath, Birmingham—Metal workers, etc. £5,000. E. Orton, E. D. Hughes and H. F. Baillie.

Robert Harpers & Company, Westminster Bank Chambers, London Bridge, London, S.E.1—Metal merchants, etc. £100. S. B. Lunzer.

G. S. Anderson & Company (Ryhall), "Cedars," Ryhall, Stamford—Founders and agricultural engineers. £2,000. G. S. Anderson and J. R. Welbourn.

Medland & Son, Beare, Broadclyst, Devon—Agricultural implement makers and engineers. £10,000. F. Johnstone, D. T. Morgan and W. P. Authers.

Jack Castle & Company, 18A, Newport Street, London, S.E.11—Machinery and metal merchants, scrap-iron merchants, etc. £1,000. J. and D. Castle.

Booth & Parry, Gwydir Chambers, 104, High Holborn, London, W.C.1—Engineers, founders, smiths, hollow-ware manufacturers, etc. £500. G. T. Booth and G. H. Parry.

Bentley, Brown & Company (Established 1921), 59-60, Gracechurch Street, London, E.C.—Machinery and metal merchants and brokers, etc. £500. M. H. and R. G. M. Cawson.

Maurice Lambot & Company, 23, Elvetham Road, Edgbaston, Birmingham—Designers and manufacturers of furnaces, gas plant, ovens and heating appliances, etc. £1,000. M. and V. M. Lambot and A. J. Curnow.

HOME GUARD SERVICE

The General Council of the T.U.C. has been seeking from the Ministry of Labour and National Service a clarification of the instructions to local officers of the Ministry with regard to the direction of men into the Home Guard.

It has been agreed that no man shall be so directed who is working 60 hours a week in industrial premises used for vital work unless local circumstances make it imperative that he should be. It has also been confirmed that, in computing the working week, any excessive amount of travelling to and from work shall be taken into consideration. In cases where a man who is working 60 hours a week or over has already been enrolled in the Home Guard, the matter is removed from the control of the Ministry of Labour and becomes one for the War Office, and the worker concerned may, in the first instance, apply to his commanding officer either for easement of duties or for discharge according to circumstances.

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With his wooden ploughshare and lumbering oxen primitive man toiled in the fields. His reward was at its best a meagre livelihood, at its worst, famine. There was never an abundance of the fruitful things of the earth.

Science and the machine magnify the individual effort and multiply the yield. Thus it is that the tractor symbolises the new era of agriculture, when no man shall toil excessively and no one should starve.

Behind these visible manifestations of knowledge and progress lie the painstaking and laborious research which has produced steels of special qualities to withstand extreme stress and of great endurance. The food of man depends on the high standard of materials produced by the metallurgists and to them man owes his existence as never before in the history of the world.

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THE SHEFFIELD COAL CO. LTD.
THE ROTHERVALE COLLIERIES, TREETON
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THOS. BUTLIN & CO., WELLINGBOROUGH

U.S.P.2.

Raw Material Markets

NON-FERROUS METALS

All the non-ferrous metals continue to be in good supply to meet war needs, which in the case of copper, especially, are very heavy. Licences and established need are still necessary preliminaries to the acquisition of metal, and the Control continues to keep a watchful eye on distribution to ensure that supplies are confined to essential uses.

Mr. J. D. Wolff spoke on Wednesday on the future of the London Metal Exchange, and made a strong plea for its retention after the war, as a free and open market. The occasion of the speech was a luncheon given to mark Mr. Wolff's retirement from the chairmanship of the Exchange, a position he has held for the past fifteen years.

Mr. Wolff recalled the important functions which the London Metal Exchange has performed from its foundation, in 1877, until the Government prohibited dealings after the outbreak of the war. It provided a market on which large tonnages could be bought and sold at any time and for varying deliveries without unduly influencing prices; it took up and financed surplus stocks; it made possible the hedging operations which are essential to take the speculative element out of the carrying of stocks; it provided a set of daily standard quotations which was accepted the world over; it contributed to Great Britain's invisible exports, a source of foreign exchange income which will more than ever be needed after this war; it provided arbitration machinery which was used, not only in its own affairs, but to settle many disputes referred to London from foreign countries. The efficacy with which the London Metal Exchange tackled its various tasks was evident from the fact that it had become by far the most important non-ferrous metals market in the world.

Mr. Wolff answered the often heard accusation that the London Metal Exchange had in the past offered its facilities to speculation. He pointed out that a large part of its forward deals were genuine producers' sales, or hedging operations. The market admittedly carried certain speculative risks, but someone had to bear these and, provided it was placed on responsible and sufficiently solid shoulders, such risk-taking was part of the functions which any well organised market should perform.

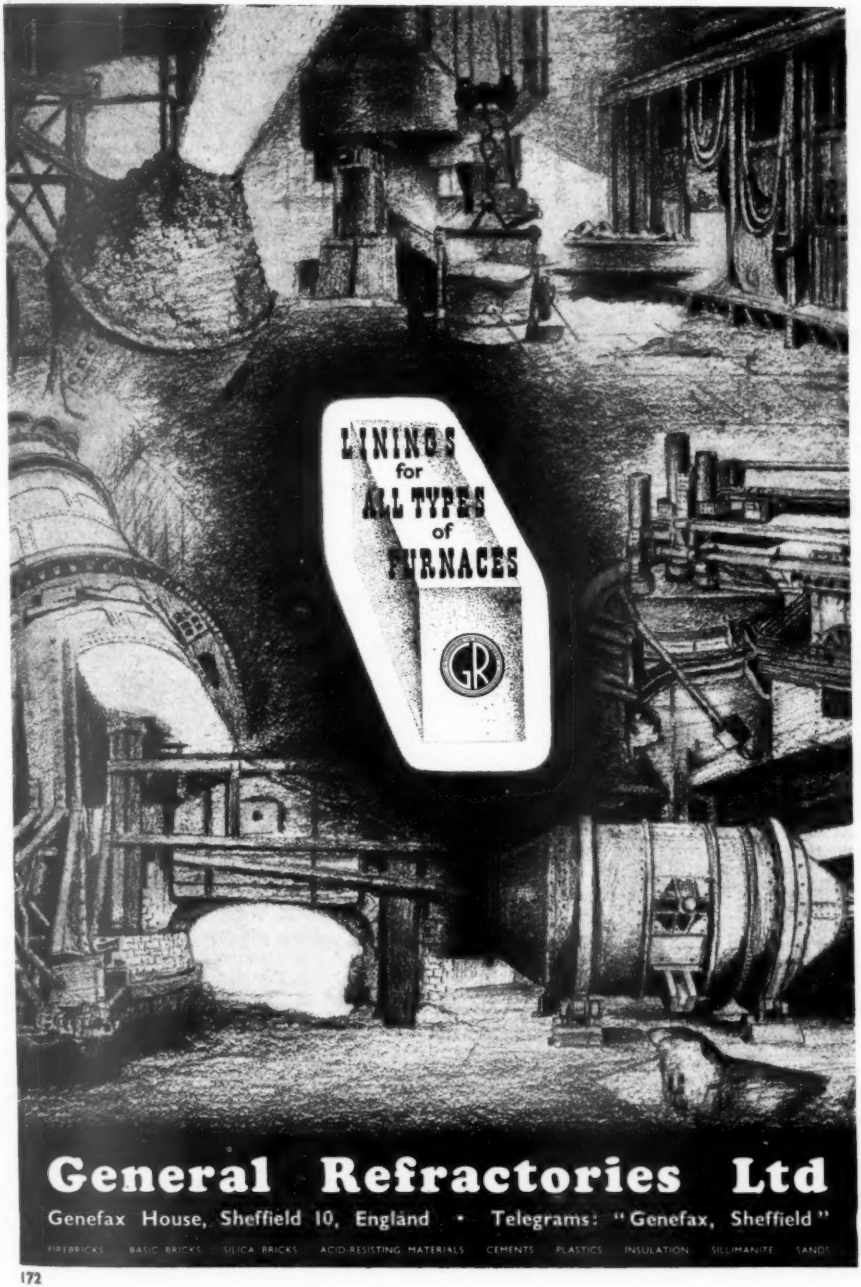
Viewing the future, Mr. Wolff expressed his conviction that the London Metal Exchange, in common with other commodity markets, should be re-established as soon as possible after the close of hostilities. One of the alternatives to a free market would be a system in which prices continued to be fixed, and supplies guaranteed by the Government. This he condemned as impracticable short of complete international agreements which would not merely guarantee supplies at fixed prices, but offer guaranteed markets in the outside world and fixed selling as well as buying prices. Moreover, Government trading would inevitably generate international political friction, since each trading operation would, under such a system, acquire a political significance, which is wholly absent when business is transacted in a free and open market.

The other alternative to the restoration of an open market would be to have prices fixed by agreement between producing interests, strengthened, in all probability, by a further agreement for the control of output. Apart from the more general objections to such restrictive devices, the monopoly prices determined by this system would hardly inspire widespread confidence. Moreover, under the cartel system, producers might be compelled to become bull speculators in their own produce. Mr. Wolff admitted that the *status quo ante* could hardly return in all its pre-war details, but he expressed his belief that as an association of many firms of long standing, and with the goodwill of mine owners, smelters, refiners and manufacturers, the London Metal Exchange could and would adapt itself to changed conditions and so continue to play a prominent and necessary part in the metal trade of the future.

IRON AND STEEL

Supplies of raw materials are adequate to the requirements of the blast furnaces, and it is generally assumed that the effect of the Italian capitulation will be to give a further impetus to the expansion of ore shipments from the Mediterranean ports. Resumption of these supplies has already made possible more liberal allocations of low- and medium-phosphorus iron, which is specially needed in the engineering foundries. Consumers of refined iron are also experiencing less difficulty in obtaining deliveries than was the case a few weeks ago, but hematite seems to be as scarce as ever. None can be used without a permit and these are only issued for approved purposes. There are plentiful supplies of high-phosphorus iron and no doubt production could be increased without any great difficulty. The light-castings trade still absorbs the bulk of the output of common foundry iron, but the total does not approach the pre-war level and is unlikely to increase greatly while the light foundries are deprived of their normal markets in the building industry and among the export trades. Coke is in ample supply, and there is no shortage of scrap.

There is no prospect of any slackening in the demand for steel plates and the assistance of the sheet mills in rolling the thinner gauges has proved invaluable. All users are now fully conscious of the wisdom of specifying their requirements well in advance and this practice facilitates the arrangement of rolling programmes and the avoidance of frequent changes of the rolls. Shipbuilders, who are accorded special priority, are also extensive users of thick sheets and the maintenance of big outputs is facilitated by an ample supply of sheet bars. The demand for special steels for aircraft production continues to increase and among miscellaneous products which are heavily specified for the fourth period, railway and colliery supplies occupy a foremost place.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CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, September 22, 1943

PIG-IRON

Foundry Iron.—CLEVELAND No. 3: Middlesbrough, 128s.; Birmingham, 130s.; Falkirk, 128s.; Glasgow, 131s.; Manchester, 133s. DERBYSHIRE No. 3: Birmingham, 130s.; Manchester, 133s.; Sheffield, 127s. 6d. NORTHANTS No. 3: Birmingham, 127s. 6d.; Manchester, 131s. 6d. STAFFS No. 3: Birmingham, 130s.; Manchester, 133s. LINCOLNSHIRE No. 3: Sheffield, 127s. 6d.; Birmingham, 130s.

(*No. 1 foundry 3s. above No. 3. No. 4 forge 1s. below No. 3 for foundries, 3s. below for ironworks.*)

Hematite.—No. 1 (S & P 0.03 to 0.05 per cent.): Scotland, N.-E. Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, 140s. 6d., delivered Birmingham.

Scotch Iron.—No. 3 foundry, 124s. 9d.; No. 1 foundry, 127s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, 174s.; South Zone, 176s. 6d.

Refined Malleable.—North Zone, 184s.; South Zone, 186s. 6d.

Cold Blast.—South Staffs, 227s. 6d.

(NOTE.—*Prices of hematite pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton.*)

FERRO-ALLOYS

(*Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.*)

Ferro-silicon (5-ton) lots.—25 per cent., £21 5s.; 45/50 per cent., £27 10s.; 75/80 per cent., £43.

Ferro-vanadium.—35/50 per cent., 15s. 6d. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 6s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 9s. 8d. lb.

Tungsten Metal Powder.—98/99 per cent., 9s. 9½d. lb.

Ferro-chrome.—4/6 per cent. C, £59; max. 2 per cent. C, 1s. 6d. lb.; max. 1 per cent. C, 1s. 6½d. lb.; max. 0.5 per cent. C, 1s. 6½d. lb.

Cobalt.—98/99 per cent., 8s. 9d. lb.

Metallic Chromium.—96/98 per cent., 4s. 5d. lb.

Ferro-manganese.—78/98 per cent., £18 10s.

Metallic Manganese.—94/96 per cent., carb.-free, 1s. 9d. lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., 100-ton lots, £12 5s.; tested, up to 0.25 per cent. C, £12 10s.; hard (0.42 to 0.60 per cent. C), £13 17s. 6d.; silico-manganese, £17 5s.; free-cutting, £14 10s. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £15 15s.; case-hardening, £16 12s. 6d.; silico-manganese, £17 5s.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £13 17s. 6d.; basic hard, 0.42 to 0.60 per cent. C, £14 10s. 6d.; acid, up to 0.25 per cent. C, £16 5s.

Sheet and Tinplate Bars.—£12 2s. 6d., 6-ton lots.

FINISHED STEEL

[*A rebate of 15s. per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.*]

Plates and Sections.—Plates, ship (N.-E. Coast), £16 3s.; boiler plates (N.-E. Coast), £17 0s. 6d.; chequer plates (N.-E. Coast), £17 13s.; angles, over 4 un. ins., £15 8s.; tees, over 4 un. ins., £16 8s.; joists, 3 in. × 3 in. and up, £15 8s.

Bars, Sheets, etc.—Rounds and squares, 3 in. to 5½ in., £16 18s.; rounds, under 3 in. to ⅜ in. (untested), £17 12s.; flats, over 5 in. wide, £15 13s.; flats, 5 in. wide and under, £17 12s.; rails, heavy, f.o.t., £14 10s. 6d.; hoops, £18 7s.; black sheets, 24 g. (4-ton lots), £22 15s.; galvanised corrugated sheets (4-ton lots), £26 2s. 6d.; galvanised fencing wire, 8g. plain, £26 17s. 6d.

Tinplates.—I.C. cokes, 20 × 14 per box, 29s. 9d., f.o.t. makers' works, 30s. 9d., f.o.b.; C.W., 20×14, 27s. 9d., f.o.t., 28s. 6d., f.o.b.

NON-FERROUS METALS

Copper.—Electrolytic, £62; high-grade fire-refined, £61 10s.; fire-refined of not less than 99.7 per cent., £61; ditto, 99.2 per cent., £60 10s.; black hot-rolled wire rods, £65 10s.

Tin.—99 to under 99.75 per cent., £275; 99.75 to under 99.9 per cent., £276 10s.; min. 99.9 per cent., £278 10s.

Spelter.—G.O.B. (foreign) (duty paid), £25 15s.; ditto (domestic), £26 10s.; "Prime Western," £26 10s.; refined and electrolytic, £27 5s.; not less than 99.99 per cent., £28 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £25; ditto (Empire and domestic), £25; English, £26 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, ex works, £37 12s. 6d.; rolled zinc (boiler plates), ex works, £35 12s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £30 10s.

Other Metals.—Aluminium, ingots, £110; antimony, English, 99 per cent., £120; quicksilver, ex warehouse, £68 10s. to £69 15s.; nickel, £190 to £195.

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16d.; rods, drawn, 11¼d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 10¾d.; wire, 10¼d.; rolled metal, 10¼d.; yellow metal rods, 9d.

Copper Tubes, etc.—Solid-drawn tubes, 15¼d. per lb.; brazed tubes, 15¼d.; wire, 10d.

Phosphor Bronze.—Strip, 13¾d. per lb.; sheets to 10 w.g., 14¼d.; wire, 16d.; rods, 16d.; tubes, 21¼d.; castings, 19d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in. wide, 1s. 4½d. to 1s. 10½d.; to 15 in. wide, 1s. 4¾d. to 1s. 10¾d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5¼d. to 1s. 11¼d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6½d. Ingots rolled to spoon size, 1s. 1d. to 1s. 9½d. Wire round, to 10g., 1s. 7½d. to 2s. 2½d., with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6½d. upwards.

NON-FERROUS SCRAP

Controlled Maximum Prices.—Bright untinned copper wire, in crucible form or in hanks, £57 10s.; No. 1 copper wire, £57; No. 2 copper wire, £55 10s.; copper firebox plates, cut up, £57 10s.; clean untinned copper, cut up, £56 10s.; braziery copper, £53 10s.; Q.F. process and shell-case brass, 70/30 quality, free from primers, £49; clean fired 303 S.A. cartridge cases, £47; 70/30 turnings, clean and baled, £43; brass swarf, clean, free from iron and commercially dry, £34 10s.; new brass rod ends, 60/40 quality, £38 10s.; hot stampings and fuse metal, 60/40 quality, £38 10s.; Admiralty gunmetal, 88-10-2, containing not more than ½ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin, £74 10s., all per ton, ex works.

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended Sept. 18, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

BRASS.—S.A.A. webbing, £48 10s.; S.A.A. defective cups and cases, £47 10s.; S.A.A. cut-offs and trimmings, £42 10s.; S.A.A. turnings (loose), £37; S.A.A. turnings (baled), £42 10s.; S.A.A. turnings (masticated), £42; Q.F. webbing, £49; defective Q.F. cups and cases, £49; Q.F. cut-offs, £47 10s.; Q.F. turnings, £38; other 70/30 process and manufacturing scrap, £46 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. Cu, £43 10s.; ditto, over 58 per cent. to 62 per cent. Cu, £38 10s.; 85/15 gilding metal webbing, £52 10s.; 85/15 gilding defective cups and envelopes before filling, £50 10s.; cap metal webbing, £54 10s.; 90/10 gilding webbing, £53 10s.; 90/10 gilding defective cups and envelopes before filling, £51 10s.

CUPRO NICKEL.—80/20 cupro-nickel webbing, £75 10s.; 80/20 defective cups and envelopes before filling, £70 10s.

NICKEL SILVER.—Process and manufacturing scrap: 10 per cent. nickel, £50; 15 per cent. nickel, £56; 18 per cent. nickel, £60; 20 per cent. nickel, £63.

COPPER.—Sheet cuttings and webbing, untinned, £54; shell-band plate scrap, £56 10s.; copper turnings, £48.

IRON AND STEEL SCRAP

(*Delivered free to consumers' works. Plus 3¾ per cent. dealers' remuneration. 50 tons and upwards over three months, 2s. 6d. extra.*)

South Wales.—Short heavy steel, not ex. 24-in. lengths, 82s. to 84s. 6d.; heavy machinery cast iron, 87s.; ordinary heavy cast iron, 82s.; cast-iron railway chairs, 87s.; medium cast iron, 78s. 3d.; light cast iron, 73s. 6d.

Middlesbrough.—Short heavy steel, 79s. 9d. to 82s. 3d.; heavy machinery cast iron, 91s. 9d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 89s. 3d.; medium cast iron, 79s. 6d.; light cast iron, 74s. 6d.

Birmingham District.—Short heavy steel, 74s. 9d. to 77s. 3d.; heavy machinery cast iron, 92s. 3d.; ordinary heavy cast iron, 87s. 6d.; cast-iron railway chairs, 87s. 6d.; medium cast iron, 80s. 3d.; light cast iron, 75s. 3d.

Scotland.—Short heavy steel, 79s. 6d. to 82s.; heavy machinery cast iron, 94s. 3d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 94s. 3d.; medium cast iron, 77s. 3d.; light cast iron, 72s. 3d.

(NOTE.—*For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less.*

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SITUATIONS

STEEL FOUNDRY METALLURGIST, 9 years' experience with Tropenas and Electric furnaces for production of light castings, knowledge of sands and moulding, B.Sc., desires change.—Box 128, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

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The Indian Iron & Steel Company, Limited, require ONE FOUNDRY MANAGER, with experience in the production of Medium and Heavy Grey Iron Castings. Experience in the production of Vertically Cast Pipes an advantage. Four years' agreement, with free passages, medical attention, unfurnished quarters, and Provident Fund. Salary according to qualifications.—Written applications (no interviews), giving full particulars of age, whether married or single, National and Armed Forces Registration Numbers, training, experience, and name of present employers, should be sent to THE SECRETARY, Overseas Man-power Committee (Ref. 1073/C), MINISTRY OF LABOUR AND NATIONAL SERVICE, Alexandra House, Kingsway, London, W.C.2.

METALLURGIST or Foreman required to take charge of Tropenas Plant in small Steel Foundry; must be fully conversant with cupola and converter; steel castings mixtures subjected to Admiralty test and requirements; permanency.—Box 944, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

HEAD FOREMAN required for Mechanised Grey Iron Foundry; must be fully conversant with machine and floor practice.—Full particulars required of age, experience, and salary desired.—Box 124, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

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FOUNDRY SUPPLIES AND EQUIPMENT.—Engineer, in regular contact with Foundries in Yorkshire, desires represent established Manufacturers. Particulars exchanged in strict confidence.—Box 104, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

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THE Proprietors of letters Patent No. 487,939, relating to the manufacture of alloys, desire to grant licences under the patent to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.—Inquiries to be addressed to CRUIKSHANK & FAIRWEATHER, 29, Southampton Buildings, Chancery Lane, London, W.C.2.

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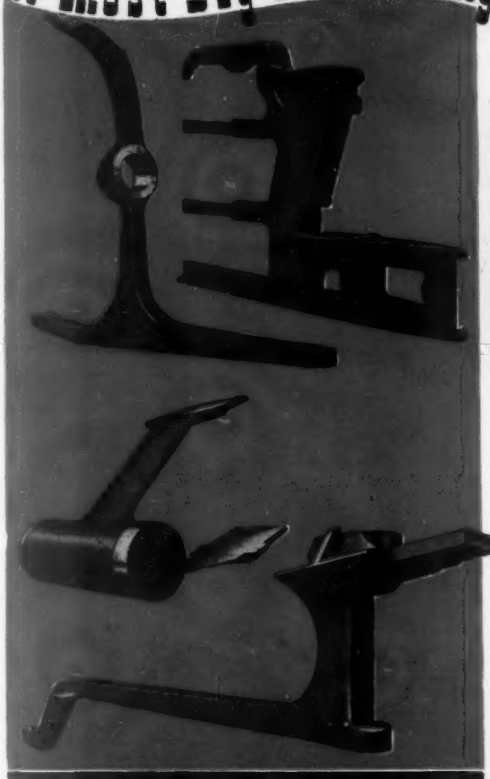

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